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# Welfare implications of overlapping ownership with endogenous quality

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## ABSTRACT

In the context of a vertically differentiated duopoly model with endogenous quality choice, we analyze the welfare effect of overlapping ownership when the market is fully covered. The results show that overlapping ownership, while detrimental for consumer surplus, may increase or decrease social welfare and firms' profits. In particular, when the overlapping ownership structure is such that the lower-quality firm acquires a positive share of the higher-quality firm's profit, an increase in overlapping ownership reduces the lower-quality firm's incentive to compete against its rival, leading to a higher level of industry profit and, therefore, a higher level of overall welfare.

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## 1. Introduction

Overlapping ownership is common in many vertically differentiated industries, such as the automobile, airline, banking, supermarket, and pharmaceutical industries (Alley, 1997; Backus et al., 2019; Newham et al., 2018; Schmalz, 2018). This study investigates how overlapping ownership affects firms' profits, consumer surplus, and social welfare when the market is fully covered, using a vertically differentiated duopoly model with endogenous quality choice.

This analysis is motivated by the fact that, in reality, many markets are fully covered. For example, all consumers who need to buy food, drink, and groceries must go shopping at a supermarket; and all patients who need first-aid supplies, patent medications, and/or other non-prescription cold medicines must go to one of the existing drugstores to purchase these items. The covered market assumption is also widely used in the literature. For example, using the Hotelling (1929) model where all consumers buy the good, D'Aspremont et al. (1979) show that firms choose maximal rather than minimal product differentiation. Assuming a Hotelling-like model where viewers are distributed along a unit interval and two channels are located at the opposite ends, Anderson and Coate (2005) present a theory on the market provision of broadcasting. Using a two-period duopoly model where all consumers buy in each period, Fudenberg and Tirole (2000)

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analyze customer poaching and brand switching, and Jing (2017) study how behavior-based price discrimination affects firms' quality differentiation and profits.

The results of our analysis show that as the degree of overlapping ownership increases, consumer surplus always decreases, but firms' profits and social welfare may increase or decrease. When the overlapping ownership structure in a duopoly is such that the higher-quality firm acquires a positive share of the lower-quality firm's profit, an increase in overlapping ownership reduces the higher-quality firm's incentive to compete against its rival, and consumer surplus loss exceeds industry profit gain, leading to a lower level of total welfare. However, when the overlapping ownership structure is such that the lower-quality firm acquires a positive share of the higher-quality firm's profit, the lower-quality firm will set a higher price and drive some consumers switch to buy from the higher-quality firm, leading to a higher level of total welfare.

Several studies have shown that because overlapping ownership induces firms to partially internalize the externalities that their actions inflict on their competitors, it can facilitate collusion (De Haas & Paha, 2021; Gilo et al., 2006), reduce entry (Sato & Matsumura, 2020), generate higher prices and lower outputs (Bresnahan & Salop, 1986; Brito et al., 2019; Dietzenbacher et al., 2000; Reynolds & Snapp, 1986; Shelegia & Spiegel, 2012), and cause consumer and social welfare to decrease (Y. Li & Zhang, 2021). However, other research has shown that overlapping ownership may raise consumer and/or social welfare<sup>1</sup> when research-and-development spillovers are sufficiently great (López & Vives, 2019; Vives, 2020), quality choice is endogenous (Brito et al., 2020), and firms engage in advertising competition (C. Li et al., 2022).

This study is closely related to Brito et al.'s (2020) research, which also uses a vertically differentiated duopoly model with endogenous quality to examine the welfare impact of overlapping ownership. However, in their model the market is partly covered; thus, product quality depends on both the structure and the degree of overlapping ownership. The authors find that an increase in overlapping ownership always decreases total welfare but may increase or decrease consumer surplus and firms' profits. By contrast, in our model the market is fully covered, and therefore, in equilibrium, firms always choose maximum quality differentiation (i.e., neither the structure nor the degree of overlapping ownership is relevant to product qualities). The results indicate that an increase in overlapping ownership always raises prices and thus, decreases consumer surplus but may increase or decrease social welfare and firms' profits.

The rest of the paper is organized as follows: After setting up the model in Section 2, we derive the equilibrium outcomes in Section 3 and identify the condition under which overlapping ownership can be welfare enhancing. Section 4 concludes the paper.

## 2. The model

Consider two firms, 1 and 2, that sell products of different quality to a continuum of consumers who have different valuations for quality. Firm 1 produces a lower-quality good and firm 2 produces a higher-quality good. Assume that the firms each hold a minority interest in the other firm; that is, firm  $i$  puts a weight  $\lambda_i \in [0, \frac{1}{2})$  on firm  $j$ 's profit  $\pi_j$ , and thus firm  $i$ 's objective is to maximize  $\Pi_i = \pi_i + \lambda_i \pi_j$ ,  $i, j = 1, 2$ ,  $i \neq j$ .

<sup>1</sup>Azar & Vives (2021) show that an increase in common ownership could stimulate economies that have multiple sectors.

Consumers who buy from firm  $i$  at price  $p_i$  obtain a utility of  $u = V + \theta s_i - p_i$ , where  $V > 0$  is large enough that the market is fully covered.  $\theta$  is consumers' preference parameter, which is uniformly distributed on the segment  $[0, 1]$ .  $s_i$  is firm  $i$ 's product quality,  $1 \leq s_1 < s_2 \leq s$ . The population of consumers is normalized to one.

To simplify the analysis and, more importantly, to compare the results directly with those in Brito et al. (2020), we follow Choi and Shin (1992), Wauthy (1996), and Brito et al. (2020) and assume that production and quality choice are costless. The timing of the game is as follows: in the first (second) stage, each firm chooses its product quality (price). Finally, consumers choose a firm from which to buy the product.

### 3. Model analysis

In this section, we analyze two cases: (1)  $\lambda_1 > 0$  and  $\lambda_2 > 0$ , and (2)  $\lambda_1 = \lambda_2 = \lambda$ . This analysis allows us to compare the results with those of Brito et al. (2020) directly.

#### 3.1. Case 1 (general case): $\lambda_1 > 0$ and $\lambda_2 > 0$

In Case 1, both firms' demand and profit functions can be easily derived as follows:  $q_1 = \frac{p_2 - p_1}{s_2 - s_1}$ ,  $q_2 = 1 - q_1 = 1 - \frac{p_2 - p_1}{s_2 - s_1}$ ,  $\pi_1 = \frac{p_1(p_2 - p_1)}{s_2 - s_1}$ , and  $\pi_2 = p_2(1 - \frac{p_2 - p_1}{s_2 - s_1})$ . The firms' objective functions are, respectively,

$$\begin{aligned} \Pi_1 &= \frac{(s_2 - s_1)(1 + 2\lambda_1(2 - \lambda_2) - \lambda_1^2(1 + 2\lambda_2))}{(3 - \lambda_2 - \lambda_1(1 + \lambda_2))^2} \text{ and } \Pi_2 \\ &= \frac{(s_2 - s_1)(4 - (1 + \lambda_1)^2\lambda_2)}{(3 - \lambda_2 - \lambda_1(1 + \lambda_2))^2}. \end{aligned}$$

Therefore, the optimal quality levels are  $s_1 = 1$  and  $s_2 = s$ , meaning that when the market is fully covered, firms always choose maximum quality differentiation to soften market competition.

Firms' prices, demands, and profits are given by  $p_1 = \frac{(s-1)(1+\lambda_1)}{3-\lambda_2-\lambda_1(1+\lambda_2)}$ ,  $p_2 = \frac{2(s-1)}{3-\lambda_2-\lambda_1(1+\lambda_2)}$ ,  
 $q_1 = \frac{1-\lambda_1}{3-\lambda_2-\lambda_1(1+\lambda_2)}$ ,  $q_2 = 1 - q_1$ ,  $\pi_1 = \frac{(s-1)(1-\lambda_1)(1+\lambda_1)}{(3-\lambda_2-\lambda_1(1+\lambda_2))^2}$ , and  $\pi_2 = \frac{2(s-1)(2-(1+\lambda_1)\lambda_2)}{(3-\lambda_2-\lambda_1(1+\lambda_2))^2}$ .

Consumer surplus and social welfare are, respectively,

$$cs = V + \frac{1}{2(-3 + \lambda_2 + \lambda_1(1 + \lambda_2))^2} \begin{pmatrix} 11 - 2s - 2(2 + s)\lambda_2 + s\lambda_2^2 \\ -2\lambda_1(1 + 2s + 2\lambda_2 - s\lambda_2^2) \\ +\lambda_1^2(2s - 1 + 2s\lambda_2 + s\lambda_2^2) \end{pmatrix}, \text{ and}$$

$$w = V + \frac{1 + 8s - 6s\lambda_2 + s\lambda_2^2 - 2\lambda_1(1 + 2s + 2s\lambda_2 - s\lambda_2^2) + \lambda_1^2(1 + 2s\lambda_2 + s\lambda_2^2)}{2(3 - \lambda_2 - \lambda_1(1 + \lambda_2))^2}.$$

Comparative statics analysis leads to the following results:

**Lemma 1:** (1)  $\frac{\partial p_1}{\partial \lambda_1} = \frac{4(s-1)}{(3-\lambda_2-\lambda_1(1+\lambda_2))^2} > 0$ ,  $\frac{\partial p_1}{\partial \lambda_2} = \frac{(s-1)(1+\lambda_1)^2}{(3-\lambda_2-\lambda_1(1+\lambda_2))^2} > 0$ ,

$$\frac{\partial p_2}{\partial \lambda_1} = \frac{2(s-1)(1+\lambda_2)}{(3-\lambda_2-\lambda_1(1+\lambda_2))^2} > 0, \text{ and } \frac{\partial p_2}{\partial \lambda_2} = \frac{2(s-1)(1+\lambda_1)}{(3-\lambda_2-\lambda_1(1+\lambda_2))^2} > 0;$$

(2)  $\frac{\partial q_1}{\partial \lambda_1} = \frac{2(\lambda_2-1)}{(3-\lambda_2-\lambda_1(1+\lambda_2))^2} < 0$ ,  $\frac{\partial q_1}{\partial \lambda_2} = \frac{(1+\lambda_1)(1-\lambda_1)}{(3-\lambda_2-\lambda_1(1+\lambda_2))^2} > 0$ ,  $\frac{\partial q_2}{\partial \lambda_1} > 0$ , and  $\frac{\partial q_2}{\partial \lambda_2} < 0$ ;

(3)  $\frac{\partial \pi_1}{\partial \lambda_1} = \frac{2(s-1)(1-\lambda_1(3-\lambda_2)+\lambda_2)}{(3-\lambda_2-\lambda_1(1+\lambda_2))^3} > 0$  or  $< 0$ ,  $\frac{\partial \pi_1}{\partial \lambda_2} = \frac{2(s-1)(1-\lambda_1)(1+\lambda_1)^2}{(3-\lambda_2-\lambda_1(1+\lambda_2))^3} > 0$ ,

$$\frac{\partial \pi_2}{\partial \lambda_1} = \frac{2(s-1)(4-(1+\lambda_1)\lambda_2-(1+\lambda_1)\lambda_2^2)}{(3-\lambda_2-\lambda_1(1+\lambda_2))^3} > 0, \quad \frac{\partial \pi_2}{\partial \lambda_2} = \frac{2(s-1)(1+\lambda_1)^2(1-\lambda_2)}{(3-\lambda_2-\lambda_1(1+\lambda_2))^3} > 0,$$

$$\frac{\partial(\pi_1+\pi_2)}{\partial \lambda_1} = \frac{2(s-1)(5-\lambda_2^2-\lambda_1(3+\lambda_2^2))}{(3-\lambda_2-\lambda_1(1+\lambda_2))^3} > 0, \text{ and } \frac{\partial(\pi_1+\pi_2)}{\partial \lambda_2} = \frac{2(s-1)(1+\lambda_1)^2(2-\lambda_1-\lambda_2)}{(3-\lambda_2-\lambda_1(1+\lambda_2))^3} > 0;$$

(4)  $\frac{\partial cs}{\partial \lambda_1} = \frac{2(s-1)(\lambda_1(2+\lambda_2+\lambda_2^2)-4-\lambda_2+\lambda_2^2)}{(3-\lambda_2-\lambda_1(1+\lambda_2))^3} < 0$  and

$$\frac{\partial cs}{\partial \lambda_2} = \frac{(s-1)(1+\lambda_1)(\lambda_1^2+2\lambda_2+2\lambda_1\lambda_2-5)}{(3-\lambda_2-\lambda_1(1+\lambda_2))^3} < 0;$$

(5)  $\frac{\partial w}{\partial \lambda_1} = \frac{2(s-1)(1-\lambda_1)(1-\lambda_2)}{(3-\lambda_2-\lambda_1(1+\lambda_2))^3} > 0$  and  $\frac{\partial w}{\partial \lambda_2} = -\frac{(s-1)(1-\lambda_1)^2(1+\lambda_1)}{(3-\lambda_2-\lambda_1(1+\lambda_2))^3} < 0$ .

As overlapping ownership induces the firms to partially internalize the externality imposed on their rivals, it allows them to increase their prices. This result differs from that in Brito et al. (2020), who show that prices may decrease with an increase in overlapping ownership. This result is different because in our model the market is fully covered, and firms choose maximum quality differentiation; however by contrast, in Brito et al.'s (2020) model the market is partly covered, such that product qualities depend on both the structure and the degree of overlapping ownership but in our model product qualities do not.

When firm  $i$  puts a positive weight on firm  $j$ 's profit, it prices less aggressively, which reduces firm  $i$ 's market share but improves firm  $j$ 's market share. Profit changes depend on both market share and price changes. A higher price  $p_i$  is helpful to improve the profit of firm  $i$ , but a lower demand for product  $i$  is detrimental for the profit of firm  $i$ . In particular, given  $\lambda_1$ , an increase in  $\lambda_2$  improves both firms' profits; however, given  $\lambda_2$ , an increase in  $\lambda_1$  raises firm 2's profit but may decrease firm 1's profit. The result that firm 2's profit increases with  $\lambda_2$  is opposite to Brito et al.'s (2020), because in our model, the higher price effect exceeds the sales loss effect.

We next address the impact of overlapping ownership on consumer surplus. First, as  $\lambda_1$  increases, the price of product 1 increases and the demand for product 1 decreases; as a result, the welfare of consumers who buy product 1 decreases. However, an increase in  $\lambda_1$  leads to both a higher price and a higher demand for product 2 (because some demand is diverted

from product 1 to product 2). The higher demand effect exceeds the higher price effect, and the welfare of consumers who buy product 2 increases; however, consumers' welfare loss from buying product 1 dominates consumers' welfare gain from buying product 2, and thus total consumer surplus decreases. Second, with the increase in  $\lambda_2$ , both firm 1's price and demand increase (some demand is diverted from product 2 to product 1), the higher demand effect dominates, and, as a consequence, the welfare of consumers who buy from firm 1 increases. However, as  $\lambda_2$  increases, firm 2's price increases but demand decreases, and thus the welfare of consumers who buy from firm 2 decreases. As consumers' welfare loss from buying product 2 dominates consumers' welfare gain from buying product 2, total consumer surplus decreases, in contrast with Brito et al. (2020), who find the opposite.

With an increase in  $\lambda_i$ , industry profit goes up, but consumer surplus goes down. For the increase in  $\lambda_1$ , the increased industry profit exceeds the decreased consumer surplus, and social welfare increases. This result differs from that obtained by Brito et al. (2020). However, for the increase in  $\lambda_2$ , the decreased consumer surplus is larger than the increased industry profit, and total welfare decreases. The intuition is as follows. As quality turns out to be fixed, when the lower-quality firm cares about the higher-quality firm's profit, it will set a higher price and force some consumers switch to buy the higher-quality product. As quality is costless (and with a covered market the price is otherwise irrelevant in terms of welfare), this leads to a higher level of welfare. However, if the higher-quality firm cares about the rival's profit, the opposite is true.<sup>2</sup>

**Proposition 1.** If  $\lambda_1 > 0$  and  $\lambda_2 > 0$ , firm 2's (1's) profit increases (can either increase or decrease) with  $\lambda_1$ , and both firms' profits increase with  $\lambda_2$ ; consumer surplus decreases with  $\lambda_i$ ; and social welfare increases with  $\lambda_1$  but decreases with  $\lambda_2$ .

The cases in the following subsections follow directly from Lemma 1 and Proposition 1.

### 3.2. Case 2: $\lambda_1 = \lambda_2 = \lambda$

In Case 2, equilibrium outcomes are given by

$$p_1 = \frac{(s-1)(1+\lambda)}{3-2\lambda-\lambda^2}, \quad p_2 = \frac{2(s-1)}{3-2\lambda-\lambda^2}, \quad q_1 = \frac{1}{3+\lambda}, \quad q_2 = 1 - q_1,$$

$$\pi_1 = \frac{(s-1)(1+\lambda)}{(1-\lambda)(3+\lambda)^2}$$

$$\pi_2 = \frac{2(s-1)(2+\lambda)}{(1-\lambda)(3+\lambda)^2}, \quad cs = V + \frac{11+5\lambda-s(2+8\lambda+5\lambda^2+\lambda^3)}{2(1-\lambda)(3+\lambda)^2}, \text{ and}$$

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<sup>2</sup>We thank a referee for suggesting this explanation.

$$w = V + \frac{1 + 8s + 6s\lambda + s\lambda^2}{2(3 + \lambda)^2}.$$

Comparative statics analysis leads to the following lemma:

**Lemma 2.**

- (1)  $\frac{\partial p_1}{\partial \lambda} = \frac{(s-1)(5+2\lambda+\lambda^2)}{((1-\lambda)(3+\lambda))^2} > 0$  and  $\frac{\partial p_1}{\partial \lambda} = \frac{(s-1)(5+2\lambda+\lambda^2)}{((1-\lambda)(3+\lambda))^2} > 0$ ;
- (2)  $\frac{\partial q_1}{\partial \lambda} = -\frac{1}{(3+\lambda)^2} < 0$  and  $\frac{\partial q_2}{\partial \lambda} = \frac{1}{(3+\lambda)^2} > 0$ ;
- (3)  $\frac{\partial \pi_1}{\partial \lambda} = \frac{2(s-1)(2+\lambda+\lambda^2)}{(1-\lambda)^2(3+\lambda)^3} > 0$  and  $\frac{\partial \pi_2}{\partial \lambda} = \frac{2(s-1)(5+5\lambda+2\lambda^2)}{(1-\lambda)^2(3+\lambda)^3} > 0$ ;
- (4)  $\frac{\partial cs}{\partial \lambda} = -\frac{(s-1)(13+14\lambda+5\lambda^2)}{(1-\lambda)^2(3+\lambda)^3} < 0$  and  $\frac{\partial w}{\partial \lambda} = \frac{s-1}{(3+\lambda)^3} > 0$ .

**Proposition 2.** If  $\lambda_1 = \lambda_2 = \lambda$ , as  $\lambda$  increases, equilibrium profits and social welfare increase with  $\lambda$ , and consumer surplus decreases with  $\lambda$ .

The first result of Proposition 2 is different from the findings of Brito et al. (2020), who show that with an increase in  $\lambda$ , total welfare decreases and the higher (lower) quality firm's profit increases (either increases or decreases). The intuition behind our results is as follows. Overlapping ownership makes firms less aggressive and thus, increases firms' prices and profits. As  $\lambda$  increases, the firms are better off because they are able to set higher prices although the demand for the lower-quality product decreases. Higher prices hurt consumers but increase total welfare because profit gain exceeds consumer surplus loss.

## 4. Conclusions

In the context of a vertical differentiation duopoly model with endogenous choice of qualities, we investigate the welfare impact of overlapping ownership when the market is fully covered. We demonstrate that overlapping ownership, while detrimental for consumer surplus, may increase or decrease total welfare and firms' profits. Our analysis provides useful implications for managers who are willing to use overlapping ownership for profit maximization. It is also useful for competition authorities who are focusing on consumer (and/or social) welfare. It highlights the importance of market coverage in understanding the profit and welfare effects of overlapping ownership. In particular, when the overlapping ownership structure is such that the lower-quality firm holds a positive proportion of the equities of the higher-quality firm, an increase in overlapping ownership increases the reluctance of the lower-quality firm to compete against the higher-quality firm, leading to a higher level of industry profit and, thus, a higher level of overall welfare.



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